CLAIMS

1. A process for improving the purity of an aqueous onium hydroxide solution which comprises:

(A) providing an electrochemical cell comprising at least four compartments, said compartments being formed by a cathode, an anode, and in order from the anode to the cathode, a first bipolar membrane, a first cation selective membrane, and a second bipolar membrane,

(B) charging the onium hydroxide solution to a feed compartment formed by the first bipolar membrane and the first cation selective membrane, wherein the feed compartment is free of ion exchange material,

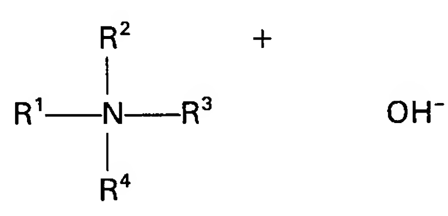
(C) passing a current through the cell, and

(D) recovering a purified onium hydroxide solution from the recovery compartment formed by the first cation selective membrane and the second bipolar membrane.

2. The process of claim 1 wherein the onium hydroxide is a quaternary ammonium hydroxide, a quaternary phosphonium hydroxide, or a tertiary sulfonium hydroxide.

3. The process of claim 1 wherein the onium hydroxide is a quaternary ammonium hydroxide.

4. The process of claim 3 wherein the quaternary ammonium hydroxide is characterized by the formula



wherein R^1, R^2, R^3 and R^4 are each independently alkyl groups containing from 1 to about 10 carbon atoms, hydroxyalkyl or alkoxyalkyl groups containing 2 to about 10 carbon atoms, or aryl or hydroxyaryl groups, or R^1 and R^2 are alkyl groups which together with the nitrogen atom may form an aromatic or non-aromatic heterocyclic

ring provided that if the heterocyclic group contains a $-C=N-$, R^3 is the second bond.

5. The process of claim 4 wherein R^1, R^2, R^3 and R^4 are alkyl groups containing from 1 to about 5 carbon atoms or hydroxy alkyl groups containing from 2 to about 5 carbon atoms.

6. The process of claim 4 wherein R^1, R^2, R^3 and R^4 are alkyl groups containing one or two carbon atoms.

7. The process of claim 1 wherein the cation selective membrane comprises a perfluorosulfonic acid, a perfluorocarboxylic acid, or a perfluorosulfonic acid-perfluorocarboxylic acid perfluoro hydrocarbon polymer membrane.

8. The process of claim 1 wherein the onium hydroxide solution charged to the cell in step (B) is derived from the elution of onium cations absorbed on a cation exchange material with an aqueous solution of an inorganic base.

9. The process of claim 1 wherein an electrolyte is charged to the other compartments of the electrochemical cell.

10. The process of claim 9 wherein the electrolyte is an aqueous solution of the onium hydroxide.

11. The process of claim 1 wherein the onium hydroxide solution charged in step (B) contains a quantity of halide ions, and the solution recovered in step (D) contains a lesser quantity of halide ions.

12. A process for improving the purity of an aqueous onium hydroxide solution which comprises:

(A) providing an electrochemical cell comprising at least 5 compartments, said compartments being formed by an anode, a cathode, and in order from the anode to the cathode, a first bipolar membrane, a first cation selective membrane, a second cation selective membrane, and a second bipolar membrane,

(B) charging the onium hydroxide solution to a feed compartment formed by the first bipolar membrane and the first cation selective membrane, wherein the feed compartment is free of ion exchange material,

(C) passing a current through the cell, and

(D) recovering a purified onium hydroxide from the recovery compartment formed by the second cation selective membrane and the second bipolar membrane.

13. The process of claim 12 wherein the onium hydroxide is a quaternary ammonium hydroxide, a quaternary phosphonium hydroxide, or a tertiary sulfonium hydroxide.

14. The process of claim 12 wherein the onium hydroxide is a quaternary ammonium hydroxide.

15. The process of claim 14 wherein the quaternary ammonium hydroxide is characterized by the formula

$$\left[\begin{array}{ccc} & R^2 & \\ & | & \\ R^1 - & N & - R^3 \\ & | & \\ & R^4 & \end{array}\right]^{+} \qquad OH^-$$

wherein R^1, R^2, R^3 and R^4 are each independently alkyl groups containing from 1 to about 10 carbon atoms, hydroxyalkyl or alkoxyalkyl groups containing 2 to about 10 carbon atoms, or aryl or hydroxyaryl groups, or R^1 and R^2 are alkyl groups which together with the nitrogen atom may form an aromatic or non-aromatic heterocyclic ring provided that if the heterocyclic group contains a $-C=N-$, R^3 is the second bond.

16. The process of claim 15 wherein R^1, R^2, R^3 and R^4 are alkyl groups containing from 1 to about 5 carbon atoms or hydroxy alkyl groups containing from 2 to about 5 carbon atoms.

17. The process of claim 14 wherein R^1, R^2, R^3 and R^4 are alkyl groups containing from 1 or 2 carbon atoms.

18. The process of claim 12 wherein the onium hydroxide solution charged to the cell in slip B is derived from the elution of onium cations absorbed on a cation exchange material with an aqueous solution of an inorganic base.

19. The process of claim 12 wherein an electrolyte is charged to the other compartments of the electrochemical cell.

20. The process of claim 19 wherein the electrolyte is an aqueous solution of the onium hydroxide.

21. The process of claim 12 wherein the onium hydroxide solution charged in step (B) contains a quantity of halide ions, and the solution recovered in step (D) contains a lesser quantity of halide ions.

22. A process for reducing the halide content of an aqueous quaternary ammonium hydroxide solution containing halide ions which comprises:

(A) providing an electrochemical cell comprising at least four compartments, said compartments being formed by an anode, a cathode, and in order from the anode to the cathode, a first bipolar membrane, a first cation selective membrane and a second bipolar membrane,

(B) charging the quaternary ammonium hydroxide solution containing a quantity of halide ion to a feed compartment formed by the first bipolar membrane and the first cation selective membrane, wherein the feed compartment is free of ion exchange material,

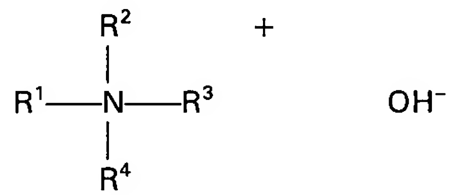
(C) charging an electrolyte to the other compartments,

(D) passing a current through the cell, and

(E) recovering an aqueous quaternary ammonium hydroxide solution from the recovery compartment formed by the first cation selective membrane and the second bipolar membrane, wherein the quaternary ammonium hydroxide recovered from the recovery compartment contains less halide ion than the amount

of halide ion present in the quaternary ammonium hydroxide solution charged to the feed compartment.

23. The process of claim 22 wherein the quaternary ammonium hydroxide is characterized by the formula



24. The process of claim 23 wherein R^1, R^2, R^3 and R^4 are alkyl groups containing from 1 to about 5 carbon atoms or hydroxy alkyl groups containing from 2 to about 5 carbon atoms.

25. The process of claim 23 wherein R^1, R^2, R^3 and R^4 are methyl or ethyl groups.

26. The process of claim 22 wherein the quaternary ammonium hydroxide solution charged to the cell in step (B) is derived from the elution of quaternary ammonium cations absorbed on a cation exchange material with an aqueous solution of an inorganic base.

27. The process of claim 22 wherein the electrolyte charged to the other compartment in step (C) is an aqueous solution of the quaternary ammonium hydroxide.

28. A process for reducing the halide content of an aqueous quaternary ammonium hydroxide solution containing halide ions which comprises:

(A) providing an electrochemical cell comprising at least 5 compartments containing water, said compartments being formed by an anode, a cathode, and in order from the anode to the cathode, a first bipolar membrane, a first cation selective membrane, a second cation selective membrane, and a second bipolar membrane,

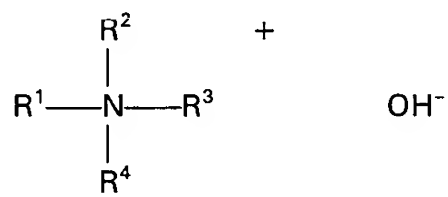
(B) charging the quaternary ammonium hydroxide solution containing a quantity of halide ion to a feed compartment formed by the first bipolar membrane and the first cation selective membrane, wherein the feed compartment is free of ion exchange material,

(C) charging an electrolyte to the other compartments,

(D) passing a current through the cell, and

(E) recovering a quaternary ammonium hydroxide solution from the recovery compartment formed by the second cation selective membrane and the second bipolar membrane, wherein the recovered quaternary ammonium hydroxide solution contains less halide ion than the amount of halide ion present in the quaternary ammonium hydroxide solution charged to the feed compartment in step B.

29. The process of claim 28 wherein the quaternary ammonium hydroxide is characterized by the formula



wherein R^1, R^2, R^3 and R^4 are each independently alkyl groups containing from 1 to about 10 carbon atoms, hydroxyalkyl or alkoxyalkyl groups containing 2 to about 10 carbon atoms, or aryl or hydroxyaryl groups, or R^1 and R^2 are alkyl groups which together with the nitrogen atom may form an aromatic or non-aromatic heterocyclic ring provided that if the heterocyclic group contains a –C=N–, R^3 is the second bond.

30. The process of claim 29 wherein R^1, R^2, R^3 and R^4 are alkyl groups containing from 1 to about 5 carbon atoms, or hydroxy alkyl groups containing from 2 to about 5 carbon atoms.

31. The process of claim 29 wherein R^1, R^2, R^3 and R^4 are methyl or ethyl groups.

32. The process of claim 28 wherein the quaternary ammonium hydroxide solution charged to the cell in step (B) is derived from the elution of quaternary ammonium cations absorbed on a cation exchange material with an aqueous solution of an inorganic base.

33. The process of claim 28 wherein the electrolyte charged to the other compartment in step (C) is an aqueous solution of the quaternary ammonium hydroxide.

34. The aqueous onium hydroxide solution obtained by the process of claim 1.

35. The aqueous onium hydroxide solution obtained by the process of claim 12.

36. The aqueous quaternary ammonium hydroxide solution obtained by the process of claim 22.

37. The aqueous quaternary ammonium hydroxide solution obtained by the process of claim 28.